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# Exploring the role of materials in policy change: innovation in low energy housing in the UK

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## **Exploring the role of materials in policy change: innovation in low energy housing in the UK**

### **Abstract**

There remains uncertainty in models of the policy process about how and when radical change takes place. Most policy authors focus on explaining incremental change, and yet in practice a pattern of change described as punctuated equilibrium has been observed, with periods of stability interspersed with periods of rapid, abrupt change. It is argued here that the influence of materials and technologies - the substance of policy - must be incorporated into models of the policy process in order to help further our understanding of radical change. Concepts from science and technology studies concerning the inseparability of social and technical spheres are used to explore how people and materials interact to create opportunities for radical change. These ideas are particularly relevant to policy sectors comprising durable, capital-intensive infrastructure, such as housing. Drawing on examples from the UK housing sector, ideas about policy networks and large technical systems are synthesised to develop a more holistic, interdisciplinary account of policy change.

### **Key words**

Policy change; innovation; large technical systems; policy networks; science and technology studies (STS).

## Introduction

The paper applies ideas from science and technology studies (STS) to models of the policy process, thereby revealing how materials and technologies influence policy making. Policy models are shown to be very one-sided, focusing entirely on human actors, and thereby ignoring the important influence of the non-human materials and technologies that policy is about. Thinking holistically about the combined influence of material infrastructure and human actors yields a more satisfactory account of how new policy ideas and innovations diffuse and become popular. Both the policy and STS literatures are large, and the discussion is therefore restricted to sub-sets of these literatures. From the policy literature, policy network models are concentrated upon. Although there are considerable differences between these models, they all endeavour to explain policy change by considering how and why policy actors coalesce into groups (Haas, 1992; Hajer and Wagenaar, 2003; Marsh and Rhodes, 1992b; Sabatier and Jenkins Smith, 1993). From the STS literature, the main body of work examined concerns large technical systems, the central idea of which is the inseparability of social and technical elements of infrastructure systems such as electricity, telecommunications and transport (Berkhout, 2002; Graham and Marvin, 2001; Hughes, 1983; Hughes, 1987; Rip and Kemp, 1998; Rohracher, 2001; Unruh, 2002; Weber, 2003).<sup>1</sup> Similarly to policy network models, large technical system theory focuses on the nature

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<sup>1</sup> A range of terminology is used by STS authors to describe socio-technical systems (see Hughes, 1987; Kemp, 1994; Rip and Kemp, 1998; Weber, 2003; Wiskerke, 2003). Large technical systems are a particular type of socio-technical system, distinguished by the durability and geographical-reach of their material infrastructure.

of relationships within socio-technical systems, and how change takes place. Reviews of these literatures can be found elsewhere (for large technical systems see Coutard, 1999; Graham and Marvin, 2001; and for policy network models see Radaelli, 1995; Smith, 1997). It is not my intention to discuss in general terms the relative advantages and disadvantages of these literatures; instead I consider what these concepts offer in terms of understanding radical change.

The main idea of policy network models is that groups of (human) policy actors work together to influence the pace and direction of policy change. The models vary, however, in terms of what factor defines network relations: discourse, beliefs, expertise, and resources are all suggested to be the 'glue' linking individuals into policy networks (Haas, 1992; Hajer, 1995; Marsh and Rhodes, 1992b; Sabatier and Jenkins Smith, 1993). There are differences too in how policy change is theorised, but a common feature is a focus on explaining stability. Radical change is rare, and is catalysed by changes in factors external to the policy network, such as shifts in economic cycles, and new political parties coming into power (Marsh and Rhodes, 1992b; Sabatier and Jenkins Smith, 1993). This feature of the models has been criticised, however, because the drivers for fundamental policy change are effectively located outside of the models (Smith, 1997). Empirical studies have found elements of policy network models to be accurate, but the general conclusion, as one might expect, is that in reality the policy process is more complex (Jordan and Greenaway, 1998; Marsh and Rhodes,

1992b; Richardson, 2000; Sabatier and Jenkins Smith, 1993). In particular, policy authors have struggled to explain the existence of periods of radical change (Jordan and Greenaway, 1998; Richardson, 2000; Smith, 2002). Historical accounts reveal sudden shifts in policy sectors, which do not fit well with network model ideas about stable policy networks leading to incremental change (Baumgartner and Jones, 1993; Davis, Dempster et al., 1966; Jordan and Greenaway, 1998; Marsh and Rhodes, 1992a; True, Jones et al., 1999). The concept of punctuated equilibrium has been used to describe this uneven pattern of policy change (John, 2003; True, Jones et al., 1999). However, the explanations proposed for punctuated equilibrium are rather opaque, and remain entirely human-focused. It is suggested that there is a fundamental, systematic oversight in the policy models, namely that the influence of the material substance of policy has been ignored.

Theories about innovation and change within the STS literature are based on the notion of periods of stability interrupted by periods of rapid change (see for example Freeman, 1994; Nelson and Winter, 1982; Phillimore, 2001; Schumpeter, 1961 for longstanding debates about economic and technological cycles). Large technical systems are conceived of as having a punctuated evolutionary pattern of growth, with stable periods of ‘momentum’ interrupted periodically by the emergence of system-wide critical problems that can only be solved by radical innovations (Hughes, 1987). The main difference between STS theories and policy models is the integral role of materials in the process of change. The use of the term

‘materials’ here refers to technologies and other physical infrastructure, essentially the non-human elements of policy. In large technical systems the problems that catalyse radical change, and the system response, are socio-technical: it is not just society that constructs problems and proposes solutions, materials themselves play an integral role – they decay, they break down, they act in unforeseen ways – and it is this agency which needs more recognition within policy network models.

A problem both literatures share is an overly simplistic distinction between radical and incremental change.<sup>2</sup> The pioneering STS author Thomas Hughes defines radical innovations as those which do not fit with the existing large technical system (Hughes, 1983), whereas policy authors define radical and incremental change less precisely (see for example Jordan and Greenaway, 1998; Kingdon, 1995). In both literatures, however, radical change is seen as catalysed by factors external to the policy sector or large technical system (Hughes, 1987; Marsh and Rhodes, 1992a; Sabatier and Jenkins Smith, 1993). But few innovations (whether technical or policy-related) are truly radical, because they tend to build on existing ideas and technologies (Graham and Marvin, 2001; Kemp, 1994). The clear separation in the literature between radical and incremental change stems from a bias towards historical case studies, particularly by STS authors (see for example Griset, 1999; see for example Hughes, 1983; Tarr, 1999), which tend to ignore unsuccessful innovations, thereby oversimplifying the process

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<sup>2</sup> For simplicity, the terms ‘innovation’ and ‘change’ are used in this context to refer to either policies or technologies (though it is recognised that in the two literatures their use is generally limited to one or the other meaning, not both).

of change (Pinch and Bijker, 1984). Research into historical and contemporary examples of radical change in the UK housing sector illustrates how in practice the distinction between incremental and radical innovation is arbitrary: there is a continuum of change (Lovell, 2005). Furthermore, the role of discourse in framing innovations as either radical or incremental is shown to be important. It is not suggested, however, that the distinction between radical and incremental change is disregarded, as it provides a useful framework for examining change, but rather that the tensions in distinguishing between these two types of innovation need to be explicitly acknowledged.

A number of examples of how materials have agency in the policy process are discussed below, drawing on examples of change in the UK housing sector. The housing sector has many of the attributes of a large technical system including a durable, ubiquitous infrastructure, a well developed social and institutional framework, and a widespread acceptance of housing technologies (Coutard, 1999; Graham and Marvin, 2001; Hughes, 1987). Where housing differs from most other large technical systems is in its long history and diverse modes of production (see Malpass and Murie, 1999 for a history of UK housing). Housing has additional complexity too in that each household is in itself a type of socio-technical system, comprising a complex assemblage of humans, materials, and technologies. The paper adopts a broad approach to examining the materiality of housing, considering the role of individual housing technologies as well as single



dwellings and housing developments. Two case studies of housing innovation are focused upon: firstly, contemporary change in response to environmental problems, in particular climate change, and, secondly, the historical and contemporary use of factory-based housing technologies. The discussion illustrates the ways in which the substance of housing - bricks, insulation, energy technologies etc. - influence the policy process. It is firstly considered how materials help explain policy stability, drawing on research about the UK energy building regulations. New radical ideas and technologies are constantly being experimented with, and maintaining policy stability is thus an active process. It is only in exceptional circumstances that radical innovations succeed and become popular. These specific conditions conducive to policy change are then explored through a wide-ranging discussion of post-war housing, contemporary plans for new housebuilding, and the role of low energy housing demonstration projects. Change is shown to be a complex *socio-technical* process. In conclusion, reflections are made on the value of synthesising models of policy and technology change.

The paper is based on the findings of a three-year ESRC-funded doctoral research project examining innovation in low energy housing in the UK. A mixture of techniques was used for the research including semi-structured interviews, focus groups, documentary analysis, attendance at key policy meetings and conferences, technical tours of low energy housing developments, and two large-scale surveys. In total, approximately seventy-

five interviews were conducted, and over thirty policy meetings and conferences attended.

### **The influence of materials on policy stability**

Policy network models reflect their origins in the wider policy literature, where there is a strong tradition of theorising incremental change, such as Lindblom's ideas about policy making by 'muddling through' (Ham and Hall, 1993; Lindblom, 1959). The idea is that networks of actors operating in a policy sector or sub-sector coalesce according to their beliefs, ideas, professional expertise and resources, and that policy shifts are slow because of their existence. Thus there is a strong element of path dependency in policy making. There are notable differences, however, between the policy models regarding the origins of network stability. For example, in the advocacy coalition framework it is because beliefs filter out incompatible new ideas (Sabatier, 1998; Sabatier and Jenkins Smith, 1993), whereas in the policy network analysis model more structural explanations are proposed, associated with the power and resources held by close-knit policy communities (Marsh and Rhodes, 1992b; Smith, 1997). The crucial difference between policy networks and large technical systems is that in large technical systems non-human materials are conceived of as influencing change. Hence it is not just the social infrastructure but also the technical components of policy sectors that affect the pace and pattern of change: habits, expertise and institutions develop over time based on the

technologies and materials that comprise each sector. Ranmert (1997: 186), for example, describes the automobile transport system as follows:

“the techno-structure of automobile traffic is a striking example of stability... [the] close coupling of things, people, and signs and its continuous production by routines are the social base of... technological momentum...”

The implication for decision makers is that the risks of trying anything new are high. Even if the status quo is not perfect, until ‘critical problems’ emerge (Hughes, 1987), it is rational to stick with existing technologies and materials that have proven operational effectiveness. In this way the existing material infrastructure has considerable influence on contemporary policy making. Historical infrastructure decisions can ‘lock in’ certain technologies (Arthur, 1989), making change increasingly difficult; a situation described variously as path dependency or momentum (Hughes, 1983; Unruh, 2002; Walker, 2000; Weber, 2003). However, momentum is not a passive state: new ideas and technologies are being aired all the time, and so there is constant effort involved in reproducing existing large technical systems, despite the impression of stability, as Graham and Marvin conclude:

"Infrastructure networks, are, in short, precarious achievements."

(Graham and Marvin, 2001: 182).

Crucially, with large technical systems there is a record of historical experiments embedded in the physical infrastructure. The infrastructure thereby serves as an important reminder of the large number of historical radical innovations that failed to diffuse more widely, remaining as discrete ‘innovation niches’ (Hughes, 1987; Rip and Kemp, 1998; Smith, 1997; Weber, 2003). These ideas are especially relevant to policy sectors comprising a durable, geographically-widespread, capital and technology intensive material infrastructure, such as housing.

In general terms the UK housing infrastructure has remained largely stable over the last century: the sector appears to have considerable momentum, dominated by incremental innovations (see Ball, 1999; Barlow and Bhatti, 1997; Barlow and King, 1992; Hooper and Nicol, 2000). Approximately eighty-five percent of new homes in the UK are built with masonry materials (NHBC, 2003), and construction methods and materials have changed little during the twentieth century (Ball, 1999; Barker, 2003; Barlow, 1999; Egan, 1998). Despite Government attempts to encourage innovation in housebuilding, most notably through the *Rethinking Construction* programme (Egan, 1998; The Housing Forum, 2003), UK housebuilders have tended to introduce changes cautiously and incrementally (Barker, 2003; Barlow, 2000). However, it is also the case that numerous radical new construction materials and technologies have been experimented with during the twentieth century, and many of these different types of housing still exist. For instance, it is estimated that in the

UK approximately one million prefabricated homes remain from the post world war periods (Ross, 2002). The first Garden Cities built in the early twentieth century and 1950s modernist high-rise estates also remain as part of the UK's housing stock: both were once promoted as radical new ideas for urban areas (Hall, 1988; Jones, 2005; Malpass and Murie, 1999). But these radical types of housing did not diffuse to become the norm. The reasons for this are complex, and are discussed in detail elsewhere (see Ball, 1999; Barlow and King, 1992; Gann, 2000; Guy, 1999), but it is suggested that conceptualising the inertia of the UK housing sector requires thinking holistically about the institutional *and* material infrastructure of the housing sector.

### ***Climate change and the energy building regulations***

The response of the UK housing sector to the problem of climate change provides a contemporary illustration of momentum or policy stability. During the 1990s climate change became a significant environmental policy issue in the UK. Through the international Kyoto Protocol the UK Government is committed to reducing greenhouse gas emissions by twelve and a half percent by the year 2010, and it also has a long-term goal to lower carbon emissions by sixty percent by 2050 (DETR, 2000; DTI, 2003a). Dwellings account for a third of the UK's final energy consumption, and the Government is relying on the residential sector to achieve a quarter of the necessary greenhouse gas emission reductions by 2010 (DTI, 2003a). But to date there has not been widespread radical change in the housing sector in

response to this important problem (Hertin, Berkhout et al., 2003), and the Government has recently admitted it will not meet its ambition of reducing carbon dioxide emissions by twenty percent from 1990 levels by the year 2010 (DEFRA, 2005). A fundamental difficulty of developing an adequate response to mitigate climate change in UK housing arises from the material presence of the existing housing stock, comprising nearly twenty six million homes (ODPM, 2004a), the large majority of which are energy inefficient (Boardman, Darby et al., 2005). Approximately forty percent of the existing housing in the UK was built before 1945 (ODPM, 2001), and new housing accounts for less than one percent of the total housing stock in any one year (Barker, 2003). The existing housing strongly frames the policy debate about residential climate change measures, tending to direct innovation at new build housing, where change is easier to effect (see for example BRE, 2001; BRECSU, 1996; Ekins, 2002; London Borough of Enfield, 2003; Pett and Ramsay, 2003).

However, there has been comparatively little progress in developing solutions to climate change with new housing. One important way of ensuring that new housing is low energy is through increasing the stringency of the UK energy building regulations. The 2003 Energy White Paper included provisions to bring forward the next upgrade of the energy building regulations from the year 2008 to 2005, mainly because of climate change (DTI, 2003a; King, 2004 pers.comm.). Thus far the dominant organisations within the housing sector have effectively withstood major changes to the

building regulations. The lack of progress to date with changing these regulations illustrates the agency of materials, or the non-human elements of housing policy. The energy component of the UK building regulations, known as Part L, outline standards for the energy performance of buildings (ODPM, 2004c). A current concern of the house building industry is that with a significant increase in the energy efficiency requirements of Part L, it will no longer be commercially feasible to continue to use masonry construction methods, and alternative methods of house building will have to be considered (Barlow, 1999; Crewe, 2002, pers.comm.; Innes, 2003, pers.comm.; Traditional Housing Bureau, 2005). In effect it would become less profitable to use masonry construction in comparison to other techniques, such as steel and timber frame building, because of the extra cost and technical difficulty of installing additional thermal insulation within walls (BRE, 1999; King, 2004, pers.comm.). Thus there is the likelihood that an increase in the stringency of Part L regulations might necessitate radical innovation in construction materials and methods. But the process for upgrading the building regulations has historically favoured incremental innovation in existing masonry house building technologies and processes. A Government guidance document outlines the rationale for changes to the building regulations as follows:

“Government requires that the measures are proportionate with other legislation bearing on the construction industry, and should allow sufficient

design flexibility *and avoid undue technical risk.*” (ODPM, 2003c: 5, emphasis added).

Thus the basis for changes to the building regulations is conservative, in the sense that precedence is given to technologies within the existing socio-technical system. Avoiding technical risk is evidently much easier with masonry technologies, which have been used for decades. In negotiations about the year 2002 amendments to Part L (DTLR, 2002), several interviewees indicated that initial proposals for a stringent upgrade in the energy performance of dwellings were dropped because of pressure from the house building industry, as one interviewee explains:

“... the [part L] building regulation changes were watered down by the brick and block industry, through their lobbying, [their] vested interests, a wasted opportunity...”

(Interview, manager at an environmental charity, August 2002).

Although Government officials deny such a straightforward account (King, 2004 pers. comm.), it is clear that there was some retreat from the original ambitious changes proposed (see ODPM, 2000); illustrating how the making of energy building regulations is fundamentally a political process (Raman and Shove, 2000). The extract below is from an interview with a manager of a Government organisation trying to promote innovation in the UK housing sector, including environmental innovations and factory-based



housing production. He too alludes to the financial and political power of the house building industry relative to Government:

“If you imposed...[regulations] that every house must be built using [factory] manufacture... What that means is everyone involved in manufacturing sand, cement blocks, bricks...their business has just gone... It wouldn't be that extreme, but it is those sort of political concerns... that is why it takes the Government so long to change building regulations....”

(Interview, head of millennium communities, English Partnerships, May 2003).

His comments illustrate how what may appear at first to be purely technical decisions about energy use in buildings, are in fact highly politicised. A further illustration of the political nature of building regulation changes is given by the manager of a small private house building company that has produced innovative low energy housing, who describes his frosty reception at a house building conference where he made a presentation about positive aspects of future upgrades to Part L:

“The discussion was about building regulations, about moving [energy] building regulations forward. And the last thing that they wanted [you] as a developer or a housebuilder to say was that any proposals being discussed at these sorts of conferences are feasible – you try to hold the whole thing

back.” (Interview, chief executive of a small private sector housebuilder, August 2002).

He reveals how housing producers are united to a high degree in opposing changes to regulations, and have mobilised their resources to prevent Part L from effecting more radical innovations. This would typically be conceived of by policy authors as straightforward lobbying from powerful actors who obviously have a strong interest in defending the viability of their business (Grant, 2000, 2004; Ham and Hall, 1993). It is argued here that a more holistic, socio-technical explanation of the situation is required, which allows for some agency on the part of housing materials. In other words, the substance of housing policy – housing materials and technologies – play a role in determining the actions and attitudes of those involved in policy change. Fundamental, radical changes in how new housing is built and planned have not been required from the previous rounds of changes to Part L: housebuilders have been able to continue to use their standard house types or plans, which are crucial to their business (see Nicol and Hooper, 1999). In this way the technology and materials of dwellings have acted as a ‘script’ (Akrich, 1992), placing boundaries on the acceptable limits of policy initiatives and strongly favouring policies aimed at incremental innovations, hence allowing the existing socio-technical system to continue with minimum disruption. Thus, despite the emergence of a radical climate change policy discourse in the UK (see Grubb, 2002; Gupta and van der

Grijp, 1999; Ott, 2001), the energy building regulations have thus far changed little.

A key part of the strategy of the housing industry has involved using discourse to frame elements of the existing socio-technical system as inevitable, or unquestionable. In particular, masonry housing has been presented as ‘traditional’, thereby creating a powerful story-line (after Hajer, 1995) about the financial and technical reliability of masonry homes. Discursive strategies are currently given insufficient attention by STS authors, who, in concentrating on the relationship between humans and technologies, rather overlook relations between human actors. Ideas from the policy literature about discourse coalitions and the discursive framing of policy problems and solutions (see Dryzek, 1997; Hajer, 1995; Rein and Schon, 1993) highlight the important ways in which discourse can be used in policy change. A UK lobby organisation called the Traditional Housing Bureau was established in the 1980s to secure the interests of the masonry house building industry, promoting masonry housing as good quality and durable (see the Traditional Housing Bureau, 2005). The strength of this ‘traditional housing’ story-line in part stems from the perceived failure of ‘non-traditional’ prefabricated housing techniques used episodically in the UK throughout the twentieth century, discussed in later sections of the paper. As Ross comments in his historical review of UK house building methods and materials:

"... the phrase 'traditional construction' is now widely used to describe brick and block [masonry]... construction whose supporters would have us believe that [it] is by far the best and most reliable way of building houses. The term also implies that non-traditional forms of construction were an attempt to displace it from an established position. *An objective review of construction practice over the last century would paint a somewhat different picture.*"

(Ross, 2002: 15, emphasis added).

Ross thereby hints at the degree of continual innovation and flux in the housing sector, thus prompting masonry housebuilders to use a range of strategies to promote their dominance, which is nevertheless constantly under threat (Ball, 1999; Barlow, 1999; Hooper and Nicol, 2000).

### **The influence of materials on policy change**

So far the discussion has concentrated on the influence of materials on policy stability; it is now considered how materials can also act in ways to promote change. The material substance of policy is important in two ways: firstly, characteristics of the existing material infrastructure affect the timing of radical change, and, secondly, the material presence of radical new ideas and technologies can help catalyse change.

### *The timing of radical change*

It is discussed above how radical innovations are constantly emerging, and yet rarely become widespread. A crucial question is therefore under what conditions radical innovations are likely to become established. If the role of the material substance of policy is considered it becomes apparent how periodically the physical infrastructure offers opportunities for change. One reason why radical ideas are sometimes successful is therefore simply good timing. Directing attention at only social and institutional factors – as policy models do – thereby misses an important determinant of radical change. It is not that policy authors have discounted the issue of timing. Kingdon, for example, discusses the importance of timing and luck in his ideas about streams of policies, problems and politics converging to produce policy change (Kingdon, 1995). But what is missing from his otherwise convincing account of the messiness of policy making is the influence of existing materials - the built environment - on the policy process.

A dramatic, unusual illustration of how radical change can be catalysed by material infrastructure is the effect of war on UK housing policy. In the aftermath of the Second World War there was a period of rapid change in the housing sector with the introduction of prefabricated housing techniques, and the construction of modernist city tower blocks (Hall, 1988; Jones, 2005; Malpass and Murie, 1999). This was only possible because much of the existing infrastructure in cities, which had previously placed a

constraint on housing policy, was removed. Thus Malpass describes one positive outcome of the two world wars on UK housing policy as follows:

"...[the wars] are generally interpreted as giving housing policy a great boost, breaking down barriers that had previously seemed insurmountable."  
(Malpass, 2000: 20).

But caution is needed in interpreting the wars as external factors driving radical change in the housing sector. The situation is more complex: post war changes were driven by a mix of issues internal and external to the housing sector, including the technology becoming available to build factory-based high-rise housing and the existence of a surplus of steel and aluminium production after the wars, as well as a shift in ideology amongst housing professionals characterised by a strong desire for innovation and change (Hall, 1988; Ross, 2002). Furthermore, a large amount of housing underwent planned demolition during the interwar periods; it was not just that it was destroyed by warfare. In the 1950s a major slum clearance programme was launched by the Government (Hall, 1988), and between fifty and seventy thousand homes were demolished each year between the late 1950s and early 1970s (Fawcett, 2002: 6).

Similar opportunities for radical change may arise through contemporary Government plans for demolition and major new housebuilding under the Sustainable Communities Plan (ODPM, 2003d). Two hundred thousand

new homes are to be built in south-east England by the year 2016, above those already planned, with the majority in the Thames Gateway area (ibid. 2003d), and thousands of homes will be demolished in low housing demand areas in the north of England (Hansard, 2005). The Sustainable Communities Plan thus offers a significant opportunity for change, whereby radical housing innovations could be introduced and experimented with cost-effectively, benefiting from economies of scale and Government support. Discussion is underway, for example, about how innovations could be used in the new housing to minimise its environmental impact, and to encourage the uptake of new housebuilding methods (Bioregional, 2005; DTI, ODPM et al., 2003; James and Desai, 2003; ODPM, 2003b; POST, 2003). Discursive strategies have been important in promoting these innovations. For example, the UK Government has attempted to discursively reframe factory-based housebuilding technologies in order to promote their adoption in new housebuilding areas, particularly the Thames Gateway, claiming:

"Modern methods of construction have an increasing role to play in achieving a *step change* in the construction industry to produce the quantity and also the quality of housing we need."

(ODPM, 2003b: 10, emphasis added).

Government has promoted the term 'modern methods of construction' to replace the more familiar 'prefabrication' (see Hansard, 2003; ODPM,

2003b; The Housing Corporation, 2003). Factory-based housing construction was a radical new idea for housebuilding in the post war periods in the UK, and is now being promoted again as a new, modern solution to contemporary policy problems, most notably a shortage of affordable housing in the south-east of England (ODPM, 2003b). It illustrates the point raised previously about how radical ideas have their origins in existing ideas and technologies (Kemp, 1994). In total, about one million prefabricated homes were built in the UK in the mid-twentieth century (Ross, 2002). However, problems arose over the quality of building materials and poor workmanship, as well as issues about housing design and aesthetics, which resulted in negative attitudes towards factory-based housing technologies. This was particularly the case for the high-rise pre-cast concrete apartment blocks popular during the 1950s and 1960s (see Ross, 2002). Further, a 'World in Action' documentary programme broadcast in the early 1980s did much damage to the reputation of timber frame prefabrication technologies, raising concerns about the water tightness and robustness of timber frame construction (ibid. 2002). A key element of the Government's current strategy to promote use of factory housing has therefore been to change the discourse about factory-based housing technologies, essentially to avoid use of 'prefabrication'. The Government's discursive strategy has involved stressing the quality of modern methods of construction, as an (implicit) contrast to historical prefabricated housing, as well as to contemporary masonry methods (Gorgolewski, Milner et al., 2001; Hansard, 2003; ODPM, 2003b; The



Housing Forum, 2001). Many of the prefabricated houses built in post war periods in the UK were designed to be temporary. In contrast, modern methods of construction are presented as high quality, durable, modern housing, complete with features such as integrated plumbing and internet access (see for example Corus Construction Centre, The Steel Construction Institute et al., 2003; The Housing Forum, 2001).

As the UK housing sector illustrates, considering changes to the material infrastructure as well as social issues helps highlight the existence of key windows for change when new infrastructure is required. Bijker and Bijsterveld allude to this in their socio-technical analysis of housing design in the Netherlands:

"... to say that [housing] technology is socially constructed is not to say that all technical artefacts are always malleable. Technology can be very obdurate after closure and stabilization processes have occurred."

(Bijker and Bijsterveld, 2000: 507).

In other words, once a technology has been physically constructed and translated from an idea into reality then the chance of radical innovation is much diminished. In the case of the Sustainable Communities Plan, there is currently a window of opportunity for radical innovation because a large amount of new housing is to be constructed. Thus certain radical technologies, such as modern methods of construction, are being actively

framed as solutions to the specific policy problems the Sustainable Communities Plan aims to address, including providing affordable housing and increasing the speed of housebuilding (ODPM, 2003b, 2003d).

### ***The role of demonstration projects***

Creating change also depends upon the characteristics of new innovations. This is to state the obvious; it is suggested more precisely that the translation of new ideas into physical entities helps promote and stabilise the idea, thus making widespread adoption more likely. It has been proposed by Rip and Kemp (1998), amongst others, that radical innovations tend to emerge at first within ‘innovation niches’, defined as relatively protected learning spaces for new technologies, comprising either a single experiment or project, or a cluster of several experiments (see Rip and Kemp, 1998; Schot, Hoogma et al., 1994; Szejnwald Brown, Vergragt et al., 2003; Weber, 2003). The idea of innovation niches builds on the important work of other STS authors, such as Shapin and Schaffer, who have examined the societal shaping of scientific experiments, highlighting how experiments are used by advocates to generate facts (Shapin and Schaffer, 1985). It is suggested here, drawing on evidence from UK low energy housing developments, that the material presence of innovation niches can similarly be critical in winning the cognitive struggle about new ideas. One problem with gaining initial support for an idea can be the difficulty of promoting it and generating positive publicity. But by translating an idea into a material form – whether it be constructing a building or demonstrating a new

renewable energy technology – the idea is given some permanence. Material objects thereby play an important role in adding stability to emerging human-technology relations, as Law explains:

"... some materials are more durable than others and so maintain their relational patterns for longer... when we embody [relations] in inanimate materials such as texts and buildings - they may last longer... Consequently, a relatively stable network is one embodied in and performed by a range of durable materials."

(Law, 1992: 5).

The idea builds on existing policy theories about change. Punctuated equilibrium theory emphasises the importance of a successful image in catapulting an issue onto the policy agenda, and thereby catalysing a period of rapid policy change whereby existing policy networks become destabilised (John, 2003; True, Jones et al., 1999). A small number of policy authors have also considered the impact of seeing new policy ideas and innovations in practice (see Guy, 2002; Guy and Osborn, 2001; Owens and Rayner, 1999). Maarten Hajer, for example, discusses the key role of policy actors' excursions to certain sites of interest, in particular when visiting forests in Scandinavia damaged by acid rain:

"A striking finding... concerned the role of meetings and excursions in the process of persuasion... these practices... can... be identified as an essential

moment in the process of proliferation and utilization of knowledge, and... policy change...”

(Hajer, 1995: 271).

Thus actually seeing the damaged trees helped catalyse shifts in policy. What is important to stress here is how the radical innovations themselves have agency: they encourage publicity, and thereby help disseminate new ideas. In turn, this helps establish credibility for the (human) actors promoting them. In other words, the innovation niche acts as literally material proof that the idea works, and thereby reduces risk for others wishing to implement similar innovations.

A small number of UK low energy housing innovation niches, or demonstration projects, have generated huge amounts of publicity, acquiring almost a celebrity status. These include the low energy housing developments of BedZed and Hockerton, which have had extensive coverage in specialist and general media (see Figure One and Table One below). Note that these developments have been classified as ‘intermediary developments’ or ‘stepping stone niches’ (Smith, 2004). Indeed, there is some ambiguity in the STS literature about the distinction between demonstration projects, innovation niches and more mainstream transitional niches; an issue that is beyond the scope of this paper (see Geels, 2004; Rip and Kemp, 1998; Smith, 2004 for further discussion). Here it is concentrated on how these housing developments may act in ways to

promote wider low energy housing innovation through their material presence.

| <b>WRITTEN MEDIA</b>       | <b>NUMBER OF ARTICLES</b> | <b>NUMBER OF PHOTOS</b>        |
|----------------------------|---------------------------|--------------------------------|
| <i>Local newspapers</i>    | 96                        | 62                             |
| <i>National newspapers</i> | 24                        | 28                             |
| <i>Technical press</i>     | 68                        | 100                            |
| <i>Magazines</i>           | 37                        | 77                             |
| <i>Books/leaflets</i>      | 29                        | 31                             |
| <i>International</i>       | 11                        | 24                             |
| <i>Sub-total</i>           | <b>265</b>                | <b>322</b>                     |
| <b>BROADCAST MEDIA</b>     | <b>NUMBER OF ARTICLES</b> | <b>MINUTES OF TRANSMISSION</b> |
| <i>Local TV</i>            | 36                        | 165                            |
| <i>Local Radio</i>         | 24                        | 125                            |
| <i>National TV</i>         | 23                        | 138                            |
| <i>National Radio</i>      | 15                        | 155                            |
| <i>Videos</i>              | 2                         | 26                             |
| <i>Sub-total</i>           | <b>100</b>                | <b>609</b>                     |

**Table 1:** Media coverage of Hockerton, January 1995 - November 2004

(Source—<http://www.hockerton.demon.co.uk/media/summary.html>, accessed May 2004, with further update from Hockerton in November 2004 (White, 2004, pers.comm).

The Beddington Zero Energy Development, or ‘BedZed’, is a low energy development in south London; the outcome of a joint initiative between the architect Bill Dunster, the Peabody Trust (a Registered Social Landlord), and the environmental consultancy BioRegional Development Group (BedZed, 2001; BRECSU, 2002; Lowenstein, 2001; The Housing Corporation, 2004). It comprises eighty-two homes; nearly half of which have been sold on the private market, and the remainder are social housing. BedZed comprises a number of environmental innovations including an on-

site combined heat and power plant, an electric car pool, rainwater tanks, and sedum grass roofs (BRECSU, 2002). Hockerton is an earth-sheltered housing development near Newark in the East Midlands. The five terraced homes have no need for central heating: large conservatories collect heat from the sun, and the walls are very well-insulated. Electricity is provided by photovoltaic panels and a wind turbine, and all wastewater is treated on-site in a reed bed (BRECSU, 2000; Hockerton Housing Project, 2003).

BedZed and Hockerton have acted as a focal point for policy makers, uniting otherwise disparate actors, and thereby creating further opportunities for innovation. They represent an important discursive story-line and thus are a “*prime vehicle of change*” (Hajer, 1995: 63). The material existence of the low energy housing is a critical reason why policy-makers wish to be associated with it, because it is proof that the ideas and technologies embedded within the dwellings work, thereby giving instant credibility to what otherwise may be dismissed as rhetoric. Table Two gives examples of UK policy documents citing BedZed. Notably, the policy documents neglect to mention how BedZed emerged in the absence of significant direct Government support. The Government has nevertheless attempted to associate itself with BedZed by frequent visits, including the launch of new policies. For example, Patricia Hewitt, the Secretary for Trade and Industry, used it as a location to announce a new government solar power initiative (DTI, 2002). Similarly, the Liberal Democrat party leader recently visited because he “was making an environment announcement later that day and

wanted a photo to go with any publicity” (BioRegional Communications Officer, 2004, pers.comm.)

| POLICY DOCUMENT   | REFERENCE TO BEDZED  |
|---|--|
| Speech by Energy Minister Brian Wilson, Feb 2002 (DTI, 2003b).  | “Demonstrations such as the developments .. at BedZed ...prove that the technologies are available to deliver practical systems.”                      |
| Royal Commission on Environmental Pollution 22 <sup>nd</sup> Report: “Energy – Our Changing Climate”                      | Has a case study box devoted to BedZed and describes it as: “the most ambitious low energy housing development in the UK to date..” (RCEP, 2000: 105). |
| Government Energy Efficiency Best Practice Programme – General Information Report no. 89                                  | “...BedZed represent[s] state-of-the-art for sustainable housing in the UK.” (BRECSU, 2002: 3).  |
| UK 2003: the Official Yearbook of the United Kingdom of Great Britain and Northern Ireland (The Stationery Office, 2003). | Double page picture spread (pp.298-299).   |
| Environment Agency report – ‘Our Urban Future’ September 2002 (www.environment-agency.gov.uk)                             | BedZed is cited as an example of a solution to climate change.   |
| The Housing Corporation (2004).   | It is used as a model case study for Registered Social Landlords “... to show how sustainable development can be achieved.”                            |

**Table 2:** Examples of UK policy documents citing BedZed

Findings from Government reports into a number of high profile low energy housing innovation niches, including Hockerton and BedZed (BRECSU, 1996, 2000, 2002) have also informed discussions about changes to the energy building regulations (ODPM, 2000; 2003a; 2004b). In addition, new policies have been forthcoming at a local level, based on the experience of BedZed and Hockerton. Sutton Borough Council, where BedZed is located,

set an important new precedent in planning procedure by awarding the development contract to the BedZed team, despite not being the highest bidder (BRECSU, 2002). Experience with BedZed has subsequently helped inform the Unitary Development Plan produced by Merton Borough Council – the neighbouring local authority – which now requires new developments over a certain size to source ten percent of their energy from renewable resources (Forum for the Future, 2004). The authors of the Government-commissioned report about BedZed stress how the development represents:

"... a powerful argument for the feasibility of a zero-carbon target for all new build."

(BRECSU, 2002: 11).

Moreover, a range of organisations has associated themselves with these low energy housing developments in order to gain credibility, not just Government. For example, the sustainable housing policy officer at an NGO involved in sustainable housing describes how they have used the BedZed low energy development to influence key decision makers:

"I think [exemplar projects] are invaluable for showing people what might be done. It is really great when we want to talk to people about sustainable housing - important people - we take them to BedZed... *and to actually see*



*it in action I think is very inspiring, rather than just talking about what it might look like.”*

(Interview, sustainable homes co-ordinator at a national environmental NGO, May 2003, emphasis added).

The material existence of low energy housing has thus been vital in convincing others of its commercial and technical feasibility. Indeed, it is because low energy housing niches comprise unfamiliar, radical innovations that demonstrating they work becomes so critical to any strategy aimed at encouraging further change.

## **Summary and Conclusions**

It has been argued here that consideration of the role of materials and technologies in maintaining stability and catalysing change helps clarify aspects of the policy process, particularly for sectors comprising durable material infrastructure, such as housing. The traditional focus of policy authors on discourse, beliefs, knowledge and resources has deflected attention away from the importance and influence of the substance of policy. STS authors conceive of change as being influenced both by humans and non-humans, and thus have something new to offer policy models. In turn, ideas from the policy literature also have value for models of socio-technical change, most notably how discourse can be used to catalyse change and maintain momentum.

By considering the influence of materials in the policy process, a more holistic, satisfactory account of change thus emerges which brings together similar concepts from the policy and STS literatures about a punctuated equilibrium pattern of change (Freeman, 1994; Hughes, 1987; John, 2003; True, Jones et al., 1999). Materials confer stability on the policy process: their physical existence acts to narrow the framing of policy debate. But it is also true that new innovations benefit from the relative stability afforded to them by being built or manufactured: the translation of ideas into durable materials assists with promotion, and helps gain credibility for the idea and for those involved, thereby lowering risk for others. Criticism of punctuated equilibrium theory as being descriptive rather than explanatory has been addressed by revealing the important role of humans and non-humans in simultaneously creating opportunities for change and withstanding it. The examples drawn upon from the UK housing sector serve to illustrate a number of aspects of the dynamic relationship between policy stability and change, in particular revealing the intimate relationship between the social and technical aspects of housing.

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